LEAD CONTAMINATION OF U.K. DUSTS and SOILS AND IMPLICATIONS FOR CHILDHOOD EXPOSURE: AN OVERVIEW OF THE WORK OF THE ENVIRONMENTAL GEOCHEMISTRY RESEARCH GROUP, IMPERIAL COLLEGE, LONDON, UK., 1981 - 1992.

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Pb contamination of environmental media has, for some time, attracted considerable attention, not least, because of the potential health risks such contamination poses. Over the past decade, the Environmental Geochemistry Research Group at Imperial College has been investigating the nature and extent of Pb contamination of U.K. dusts and soils. Initially, a national survey carried out in 1981-1982 confirmed widespread occurrence of elevated levels Pb in U.K. garden soils and dusts. The highest Pb levels were found occur in old Pb mining areas (geochemical "hotspots") and in the city of London. In the case of latter, this likely resulted from a long history of occupancy, industrial activity and high traffic densities. In addition, house dust and garden soil Pb levels were found to be well correlated with each other and with age of house. This relationship was subsequently confirmed by two detailed studies in the town of Brighton and the city of York. A follow up investigation of Pb intakes by 2 yr olds children in inner city Birmingham demonstrated the relative importance of various sources of environmental Pb. These were evaluated by multiple linear regression, and a significant relationship was found between floor dust Pb loading (and concentration) and blood Pb (PbB). In this situation, it was also found that the main route of exposure was through hand-to-mouth activity (accounting for approx. 50% of the intake).

Automated scanning electron microscopy and energy dispersive X-ray (SEM/EDX) analysis was subsequently adopted as a method for apportioning the sources of Pb in dusts. Initially, a database of chemical fingerprints of Pb particles of known origin (from road dusts, garden soils, auto exhausts, Pb-based paints and high temperature emission processes) was created to act as a reference source to which Pb particles of unknown origin could be matched. A detailed classification scheme was defined for assigning Pb particles of unknown origin by identifying homogenous sub-groups of particles in the database using a divisive hierarchical cluster analysis. A direct classification procedure was adopted with potential areas of uncertainty assessed using a simple descriptive apportionment procedure. The apportionment results subsequently obtained from size and density separated floor dusts collected from homes in the London Borough of Richmond, suggested that in this residential urban area, garden soil Pb, road dust Pb and Pb-based paint make significant contributions to Pb in the finest (sub 64 micron) range of the dust, while the coarsest dust is dominated by paint.

To further elucidate the mechanisms of exposure to Pb from dust, SEM/EDX analysis was employed to characterize the sources of Pb on the hands of young children. A Pilot study conducted with a play-group in inner London found that only a minor quantity of the material on the children's hands contained Pb. A similar study undertaken with children in the old Pb mining village of Winster, Derbyshire found higher hand Pb levels. Analysis of soils in this geochemical "hotspot" found that the Pb mineral pyromorphite [$Pb_5(PO_4)_3Cl$] is an important soil component. This stable Pb phosphate, which is thought to be a weathering product of other Pb minerals was also found in dusts and on children's hands. Analysis of PbB levels indicated that the uptake in Winster children is low if the exposure model proposed for Birmingham is considered applicable. It is hypothesized that the low solubility of pyromorphite results in low uptake and therefore low PbB levels despite a likely elevated intake. In Winster, soil appears to be an important source of exposure, and pyromorphite seems to provide a useful tracer for estimating the contribution from external sources to Pb in housedust and on the hands of children. In addition, it appears that the degree of uptake is related to the chemical speciation of the Pb.